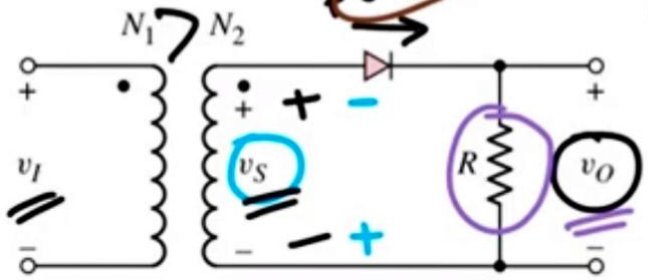
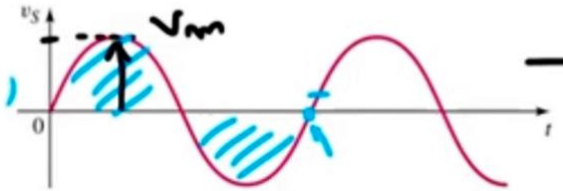
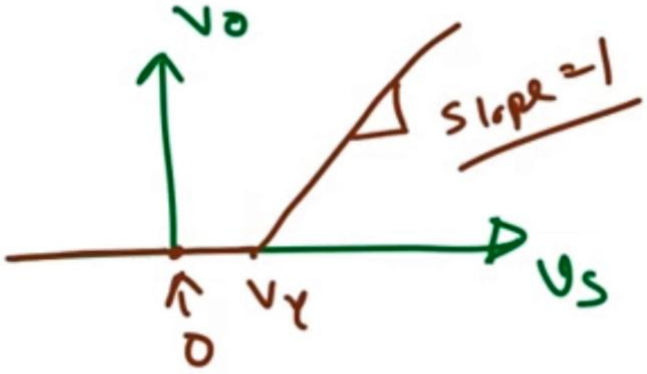
# Half-Wave Rectifier

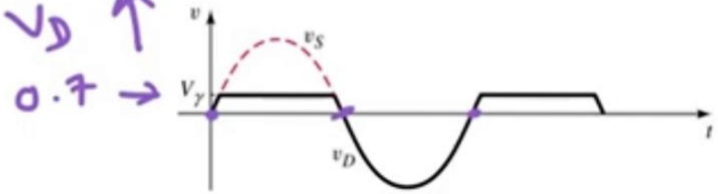


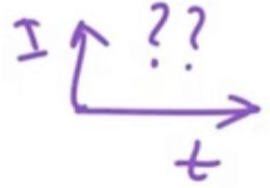

(a)


(b)



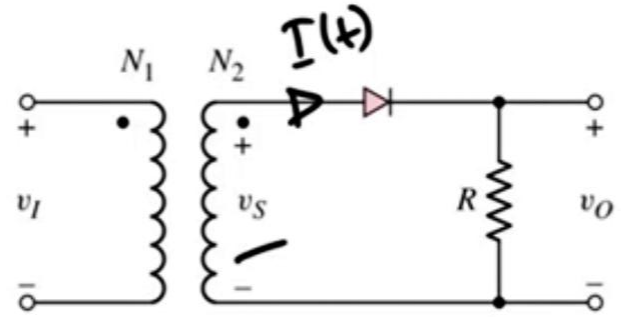




(c)




Source: Electronic circuits: Analysis and Design –by D. A. Neamen, McGraw-Hill

# Half-Wave Rectifier




$$I(t) = I_m \sin \omega t, \quad 0 < t < \frac{T}{2}$$

$$= 0 \qquad \frac{T}{2} < t < T$$


$$\omega = \frac{2\pi}{T}$$

$$I_{avg} = \frac{1}{T}\int_0^T I(t)\,dt = \frac{1}{T}\left[\int_0^{T/2} I_m \sin \omega t\,dt + 0\right] = \frac{I_m}{T}\left[-\frac{\cos \omega t}{\omega}\right]_0^{T/2}$$


$$= \frac{I_m}{T} \times \frac{T}{2\pi}\left[-\cos\left(\frac{2\pi}{T} \times \frac{T}{2}\right) + \cos 0\right]$$

$$I_{dc} = I_{avg} \rightarrow = \frac{I_m}{2\pi} \times 2 = \frac{I_m}{\pi}$$

$$V_{avg} = \frac{V_m}{\pi}$$

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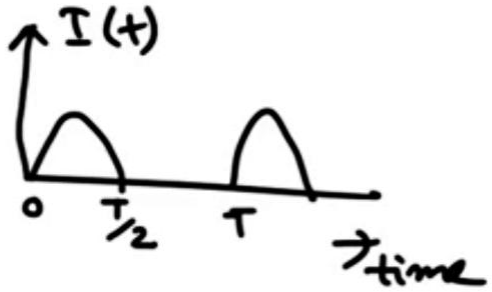
# Half-Wave Rectifier




$$I_{rms} = \sqrt{\frac{1}{T}\int I^2(t)\,dt}$$

$$I_{rms}^2 = \frac{1}{T}\int_0^{T/2} I_m^2 \sin^2\omega t\,dt$$

$$= \frac{I_m^2}{T}\int_0^{T/2} \frac{1-\cos 2\omega t}{2}\,dt$$

$V_{rms} = ?$

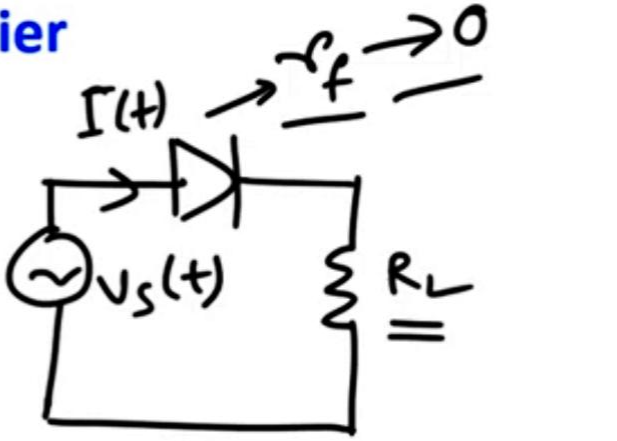
$$= \frac{I_m^2}{2T}\left[t - \frac{\sin 2\omega t}{2\omega}\right]_0^{T/2}$$

$$= \frac{I_m^2}{2T}\left[\frac{T}{2} - \frac{\sin\frac{2\pi}{T}\times\frac{T}{2}\times 2}{2\omega} - 0 + \frac{\sin 0}{2\omega}\right]$$

$$I_{rms}^2 = \frac{I_m^2}{2T}\times\frac{T}{2} = \frac{I_m^2}{4} \quad ; \quad I_{rms} = \frac{I_m}{2}$$

# Half-Wave Rectifier

$I_{dc}$, $I_{rms}$



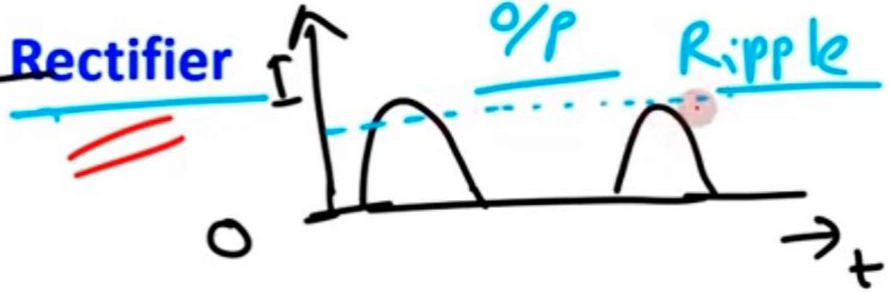

$$\text{Efficiency} = \frac{\text{DC O/P power}}{\text{AC i/p power}} \times 100\%$$

$$= \frac{I_{dc}^2 \times R_L}{I_{rms}^2 \times R_L} \times 100\%$$

$$= \frac{I_m^2/\pi^2}{I_m^2/4} = \frac{4}{\pi^2}$$

$$= 40.6\%$$

# Half-Wave Rectifier




## Ripple Factor (r)

$$r = \frac{I_{r\,rms}}{I_{dc}}$$

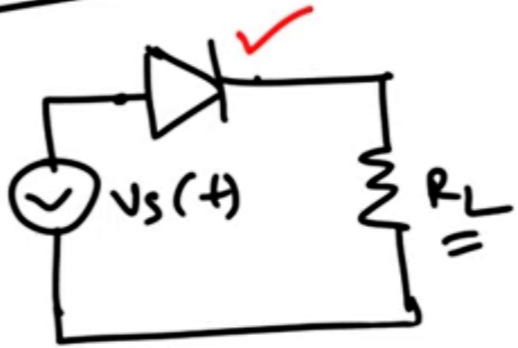
$$I_{rms}^2 = I_{dc}^2 + I_{r\,rms}^2$$

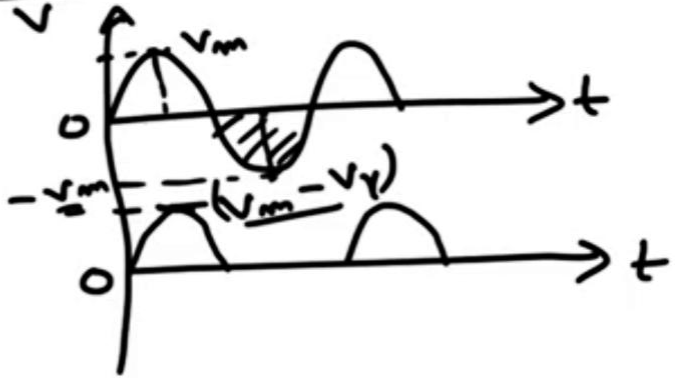
$$I_{r\,rms} = \sqrt{I_{rms}^2 - I_{dc}^2} = \sqrt{\frac{I_m^2}{4} - \frac{I_m^2}{\pi^2}} = 0.385\, I_m$$

$$r = \frac{I_{r\,rms}}{I_{dc}} = \frac{0.385\, I_m}{\frac{I_m}{\pi}} = 1.21$$

# Half-Wave Rectifier

## Peak Inverse Voltage (PIV)



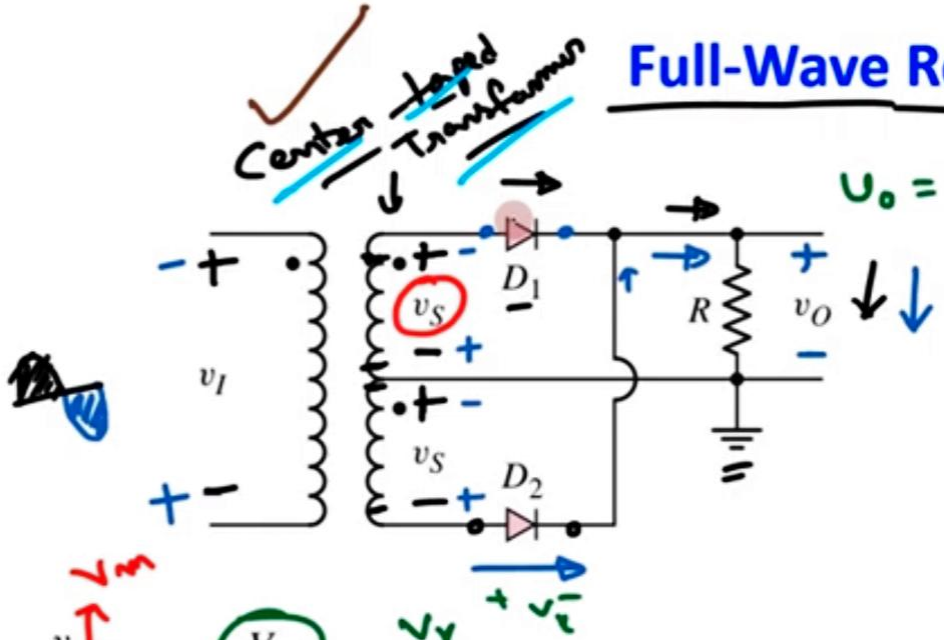

$V_s(t) = V_m \sin \omega t$

PIV H.W.R = $V_m$ < Breakdown voltage of the diode.

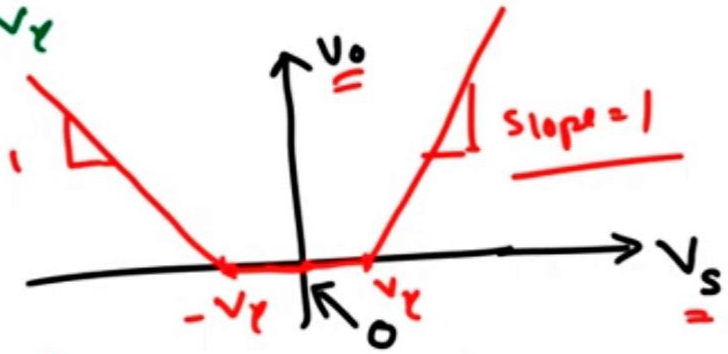
B.D.V. 20V

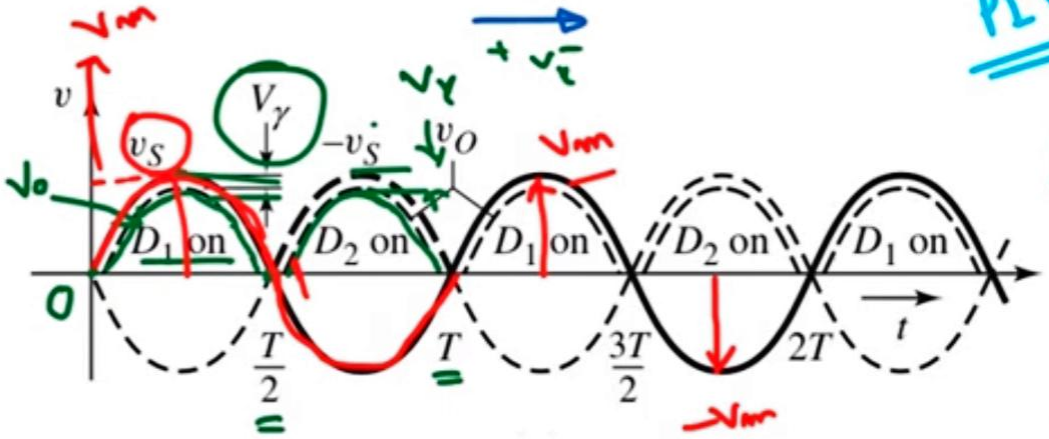
12-15V

# Full-Wave Rectifier

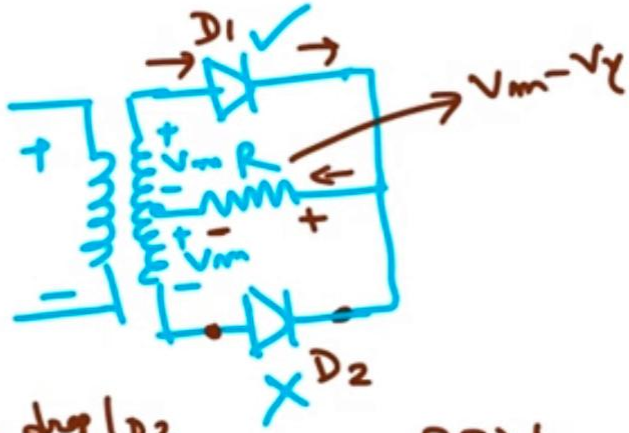



$v_O = v_S - V_\gamma$




PIV ??




voltage drop $D_2$

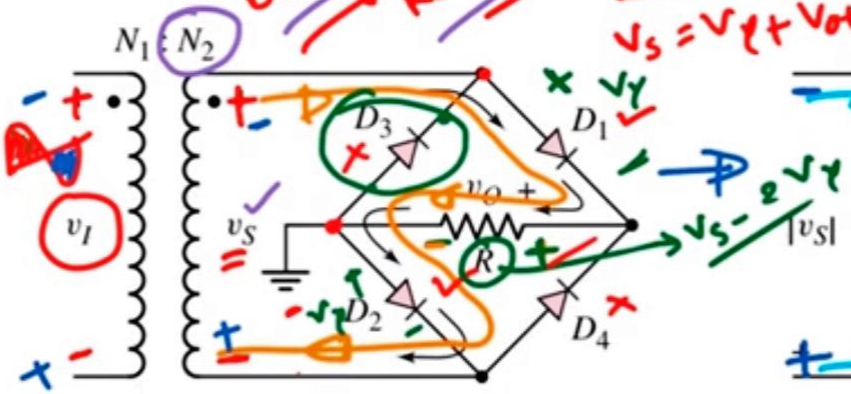
$= 2V_m - V_\gamma = PIV$

Source: Electronic circuits: Analysis and Design –by D. A. Neamen, McGraw-Hill

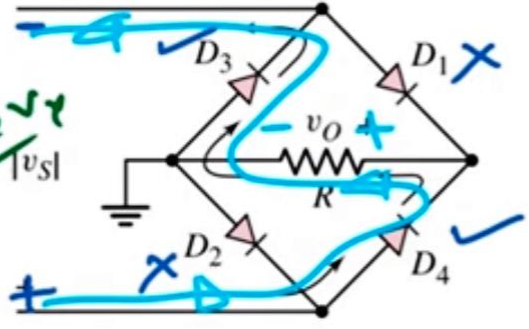
# Full-Wave Rectifier

Bridge Rectifier

$v_S = V_\gamma + V_o + V_\gamma$, $V_o = V_S - 2V_\gamma$




(a)




(b)

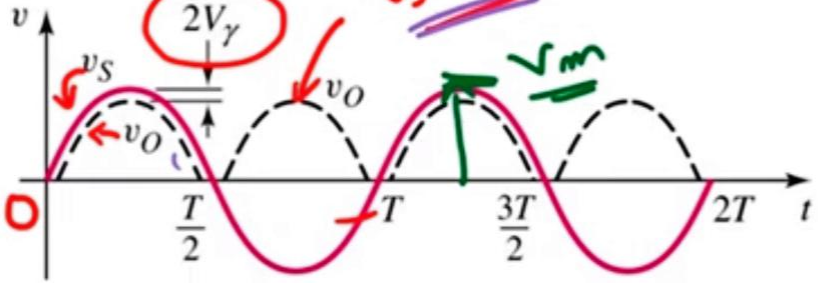
Drop across

$D_3 = V_S - 2V_\gamma + V_\gamma$

$= V_S - V_\gamma$

$V_{D3}|_{max} = V_m - V_\gamma$

$PIV = V_m - V_\gamma$




(c)

Source: Electronic circuits: Analysis and Design –by D. A. Neamen, McGraw-Hill

# Full-Wave Rectifier


$I_{avg}$ or $I_{dc} = \frac{2I_m}{\pi}$

$I_{rms} = \frac{I_m}{\sqrt{2}}$

$$\text{Efficiency } (\eta)\ (\%) = \frac{\text{O/P DC power}}{\text{I/P AC power}} \times 100\%$$

$$= \underline{81.13}\ \%$$

Half-wave, $\eta = \underline{40.6}\ \%$

Ripple Factor = 0.48

, u u P.F. = 1.21